

## ***Green Foundations: A framework for responsible design***

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### **Abstract**

Issues of sustainability are of paramount concern for architectural education and questions often revolve around how and when they should be introduced. This paper argues that a truly sustainable approach involves a paradigm shift that must be introduced via studio culture as well as project problem sets from the outset so that the studio environment instills ecological values and sensibilities throughout the design process. Responsible designers identify opportunities and exigency in their context first, and work to create ecological, systemic, permeable constructs that positively interact with the natural world. Such work requires understanding the architects' role in design and production as part of a web of relationships, constantly in flux. Hence, genuine attention to first principals of sustainability in the design curriculum necessitates a reconsideration of predominating modes of thought in architectural education and involves a shift in emphasis from static figural identification to dynamic pattern recognition. The project-based architectural design studio is an ideal environment through which alternative conceptual frameworks can emerge. The studio provides the critical social mesh where a networked, multi-disciplinary educational strategy can give rise to an integrated and responsive curriculum from "beginnings to ends". This paper focuses on suggestions for beginning design studios, setting the context for an approach to reshaping the discourse of architectural design education. Ergo, this paper will present no solutions, but will offer food for thought to stimulate like-minded educators to create environments for responsible, responsive decision making that is the base and basis of sustainable design.

### **Introduction**

Responsive decision-making involves a process of seeing, responding, making sense of, and adapting - continual activity within a world that is itself a fluid patterning of interactions. Genuine response means that the designer "must first become aware that reality is not necessarily as he believes it to be."<sup>1</sup>



Opening image in Gregory Bateson's *Steps To An Ecology of Mind*, Balinese painting by Ida Bagus Djati Sura, 1937

This perception is not new, it is a recurrent idea of collective thought – through millennia – that has been most recently propounded for generalists, like architects, by respected synthesizers like Fritjof Capra in *The Web of Life* (1996)<sup>2</sup>, and earlier by Morris Berman in *The Reenchantment of the World* (1981).<sup>3</sup> Both of these books extensively reference and give new relevance to the work of Gregory Bateson, a thinker who defies modern classification – anthropologist, cyberneticist, and systems thinker - who was influenced by his famous Edwardian Naturalist father's interests in zoology, biology, natural history, and evolution.<sup>4</sup> In the introduction to Bateson's *Steps to an Ecology of Mind* (1972) Mark Engel, a student of Bateson, quotes "we create the world that we perceive, not because there is no reality outside our heads, but because we select and edit the reality we see to conform to our beliefs about the sort of world we live in." Engel continues by summarizing Bateson's *epistemological premises*, the fact that for a person, for our purposes a designer, "to change his basic, perception-determining beliefs he must first become aware that that reality is not necessarily as he believes it to be."

To further explicate this sensibility we offer two images. The first, Escher's "Three Worlds" (1955), depicts the complex ecology of conscious and subconscious that comes together in the formation of individual and collective thought. The image suggests notions of consciousness as scum upon a pond, the undercurrents below the pond's surface are inhabited by magnificent carp that perhaps are more influential than the trees, above ground, that are reflected in the scum. The second photograph, from *Natural Geographic*, seems to be of a shark taken below the surface of the water. But if we look at it another way the photograph is of everything BUT the shark: it is the undulating plant, the root crevices protecting the most delicious small fish, the sprinkles of enticing food stuff on the waters surface, etc. Taken together we find these two images evoke the interdependency of organisms and the fluid, protean soup or hypersea wherein we dwell. Bateson saw these relationships in terms of patterns and he borrowed a word from philosophy for the kind of thinking that involved pattern recognition; Bateson proposed abduction, used most strictly to mean "a lateral extension of a

network of interrelated propositions.”<sup>5</sup> For Bateson, Abduction goes beyond induction or deduction to characterize both human species and other creatures in their environment. This interdependency, or networked thinking, is a sensibility that we feel is important to introduce from the very beginnings of design education, particularly architectural education since the design of shelter for dwelling within and in harmony with this interdependent ecology is perhaps our first mission. This networked thinking must be introduced early in the design students education in the interest of establishing a balance in what Bateson calls the “double requirement” of the social system and the students’ ideas of nature. An agenda of architectural education could be to make the workings of the protean soup visible.



(left) M.C. Escher *Three Worlds*(1955). Escher Foundation, The Hague.

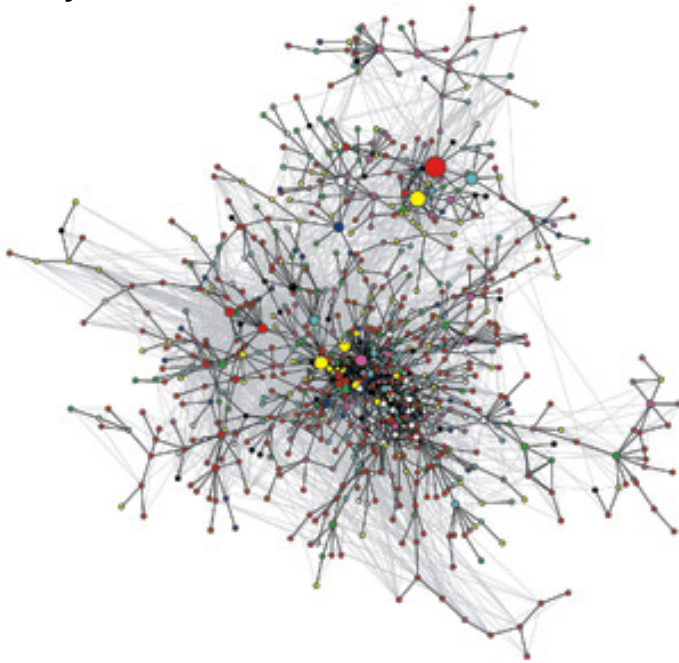


(right) “An Eden for Sharks” photo by Brian Skelly, National Geographic, March 2007 Vol 211no. 3

The following guidelines serve as the datum through which we evaluate both the studio environment and project problem sets intended to promote sustainable ends:

- 1) Studio culture should emulate that of an ecologically responsive civilization, promoting recognition of the intertwining of human vicissitude with those of a fragile, yet abundant earth.
- 2) Studio inspiration should be drawn from fundamental patterns of existence, for example those of the sun, wind, local/site specific climate conditions and materials.
- 3) Studio means should be consistent with ends: a collaborative, interdisciplinary atmosphere should be fostered.

## Body of Text



(left) Blogosphere diagram representing interconnectivity.

[www.thersswebblog.com/?guid+20060713090100](http://www.thersswebblog.com/?guid+20060713090100)

*“Ideas about nature, however fantastic are supported by their social system; conversely, the social system is supported by their ideas of nature”<sup>6</sup>*

Through the convergence of computer technologies and, particularly the Internet, our social workings begin to approach the complexity of protean soup. Each successive generation of students is more “plugged in” and more cognitive of this advancing situation. It makes sense that the studio, an interactive and exploratory environment, would not only engage but also emulate this perception of the world. Gregory Bateson’s thought, dealing with the intertwined nature of dynamic systems, provides us with ways of perceiving the structures emerging from this world.

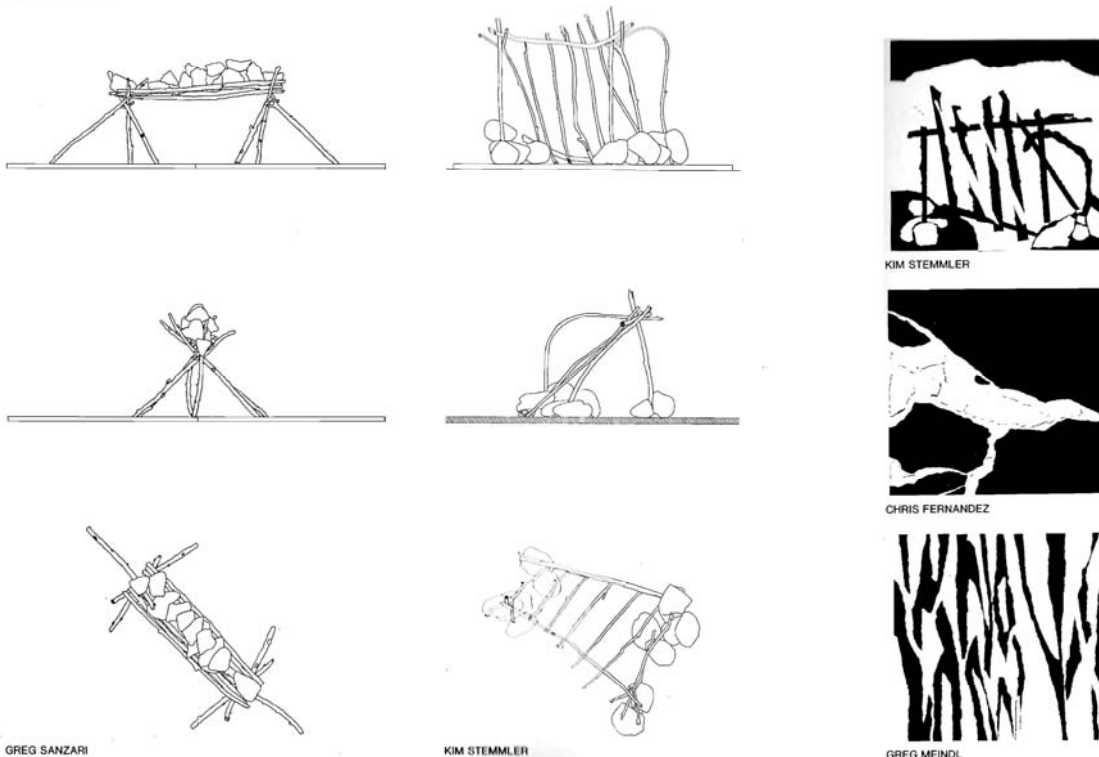
Sustainable design requires a shift in thinking that is informed by the patterns occurring all around us. This shift must occur early in the educational process and does not necessarily require re-vamping of architectural curriculum. Instilling ecological values and sensibilities as an integral part of an interdependent network that informs decision-making in the design process would continue throughout education and into profession.

By way of introduction one might start by observing animal architecture in a specific context. The weaverbird gathering flexible sticks to make their nests could be likened to gathering material for building in our own contexts. The patterns to be studied would include static observation of the seductive weave, shape or form of the nests, but more importantly an understanding of the

dynamic relationship of nest building to local ecology in terms of materials and waste.

The following are examples of studio projects where attempts have been made to provide conceptual frameworks within which such sensibilities could evolve.

At New York Institute of Technology (NYIT) we used to give a problem on the very first day of Design Fundamentals I, the first architectural studio design course in the architectural education sequence, which addressed some of these issues. In the problem, from Jonathan Friedman's *Creation in Space*, students were asked to gather 12 sticks and 12 stones from their environs (at our Manhattan campus they gathered in Central Park) and to construct a simple structure. In some ways this project is exemplary because it emulates the shelter making process of animals. The students had to make choices when gathering material of odd sizes from a local context, they then brought the material back to the studio and, without glue, had to make it into a larger construct presuming structure and shelter. The construct would be documented so as to teach plan, section, shadows and even orthographic projection. Too soon the sticks and stones were turned into white cubes (point) and rods (line) and, with planes, developed into an architecturally more palatable "Kit of Parts".



Gregory Bateson analyzes the craft (*skill*) and implications (*redundancies*) of a Balinese ink painting by Bagus Djati Sura's in the opening of his book *Steps to an Ecology of Mind* (1972) in terms of repetitive patterns, those that are second nature - as in the case of the work of a "gifted American carpenter-architect" –

and those that are “the exception” – the “almost universal linkages in aesthetics between skill and pattern”. The following examples of beginning design student projects are intended to explore “the Intermediate case,” as in Balinese carving where Bateson explains “the natural grain of the wood is rather frequently used to suggest details of form or surface of the subject.” The notion of collecting and re-using could be extended to found objects and elements that are cast off as well. As Bill McDonough has written: Waste = Food.<sup>9</sup> We also admire Samuel Mockbee’s work with Rural Studio in this respect.



(left) example of Balinese woodcarving

<http://alg2006.blogspot.com/2007/03/bali.html>

The second semester of beginning design at Penn State is dedicated to understanding material and place. Faculty members James Kalsbeek, Jodi LaCoe, and James Wines took this study of materials and detailing to another level by introducing material reclamation and reuse as an important theme of the studio. During the 6-7 week project, students study the inherent value of history and patterns in the materials that they scavenge and glean to reinterpret the old through design and to build new useful objects.

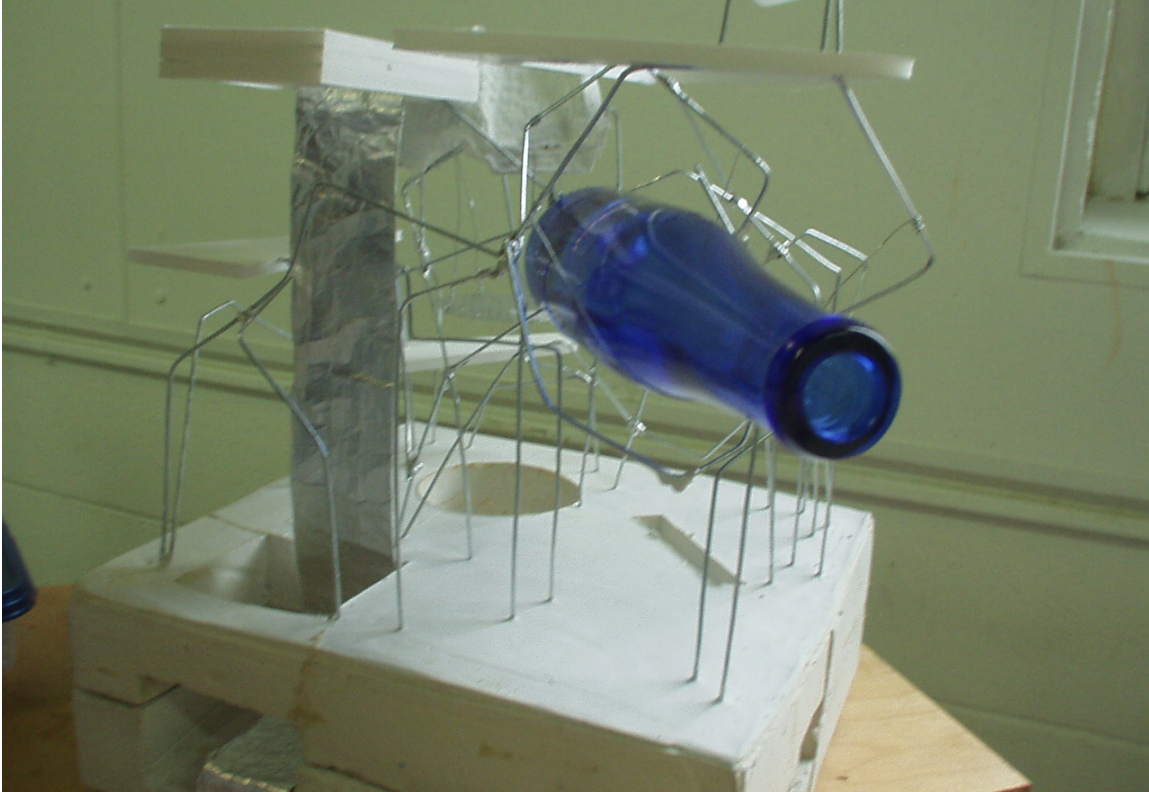
In 2005 Penn State’s School of Architecture and Landscape Architecture moved into the new LEED-gold certified Stuckeman Family Building, abandoning the 93-year old Engineering Units. James Kalsbeek, Associate Professor of Architecture, recognized potential in the resulting partial demolition of the building and individually mounted a battle to save the history and energy embodied in the construction materials of Engineering Units D & E. He coordinated a salvage effort to harvest the building materials and established FLOYD, the “Facility for Laborious Optimization of Yesterday’s Debris,” to archive the materials for reuse in student projects.



Jodi LaCoe brings cycles to the dumpster-diving concept by establishing projects that recognize the inherent value of the materials her students' salvage. In reaction to the recent devastation following Katrina, Jodi's students worked with clients in Mississippi to understand their need and reused materials salvaged following the hurricane to create furniture for hurricane victims. One example in particular, a fish-cleaning table designed and constructed by two first-year architecture students, harkens back to Ecsher's "Three Worlds." Designed for a fisherman and his wife whose lives were devastated by the aftermath of hurricane Katrina, the concept and related materials are intended to remind us of uncertainty and interconnectivity - the countertop is reflective and rippled like the surface of the pond; below the "water" is the ever-shifting and less known aspects of reality. The students' use of stainless steel for the countertop (one of a few new materials accepted for use in the studio) juxtaposes the dual nature of something that is at once transparent and also a barrier. The drawers below the surface, constructed of reclaimed wood, all slide and shift.

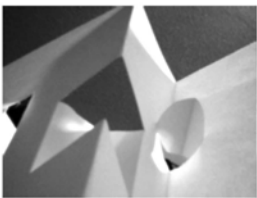


At NYIT new and pristine materials are still preferred to the potential of reading the patterns implied in found objects. Despite this preference, "junk" found in studio wastebaskets has been clandestinely inserted into a project disguised as a fundamentals exercise, encouraging the students to "read" the properties of the found materials and invent appropriate solutions for unifying relationships between old and new.

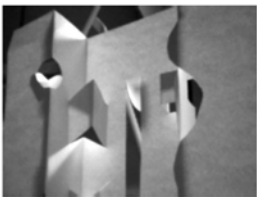


In terms of architectural education, one would seek to make visible the patterns of sun, tides, wind, rainfall, and biomass as they intersect with our human necessities so as to find, in Bateson's words, the "patterns that connect".

Any project assignment that brings the natural world into the studio in ways that reveal its patterns could introduce systems thinking and our dependence on the natural world. But the projects problem sets have to be carefully thought out. Certainly students of architecture, who design impermeable surfaces, should be aware of the water shed from those surfaces and know where the water goes. They should be aware of the hydrological cycle and the opportunities a designer has to creatively deploy water so that architecture is a contributing participant in this process.



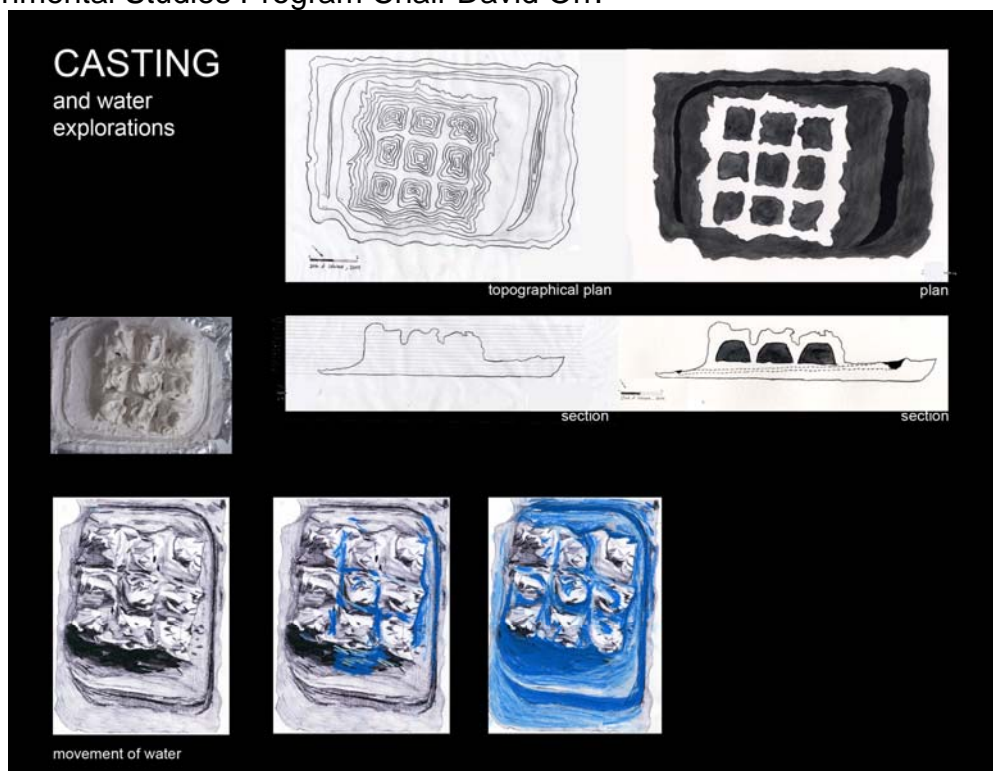
Rather than understanding folded paper as merely an exercise in form making, this fundamental project is an opportunity to introduce beginning architecture students to the integrated patterns of space, structure, and light.





Students, in fact designers in general, often mistakenly believe that water is simply a surface problem. This was the unexpected downside of a NYIT Architectural Design Fundamentals project. The project was intended to introduce contours and water simultaneously as a process of exploration and perception. The students were asked to develop plaster models that would have cavities and contours to support interesting patterns of water flow and water storage. After the plaster casts were complete and the contours were documented, everyone was supposed to pour a gallon of water with food coloring from a watering can (emulating rain) onto his or her project. However, throughout the exploration we failed to realize that the water has to go somewhere! We ended up having huge, ecologically questionable aluminum cooking pans filled with colored water under each project. With chagrin it was realized that despite the limited opportunity of surface manipulation to make visual the patterns of water, with a bit more initial thought the project could have also introduced subsurface issues of aquifers, cisterns and even the hydrological cycle. An unintended lesson of the project was the necessity for collaboration; with a little collaborative teamwork the water could have centrally collected the water and redeployed it in Central Park or into the office plants.

Building upon the basic patterns of water flow and collection, and more interestingly for architectural creation, is the redeployment of gathered water so that it contributes to fresh water purification using natural processes such as in a simple rain garden or the living machines (reinvented by Dr. John Todd and winningly employed in the Adam Joseph Lewis Center for Environmental Studies at Oberlin College by William McDonough + Partners in collaboration with the Environmental Studies Program Chair David Orr.



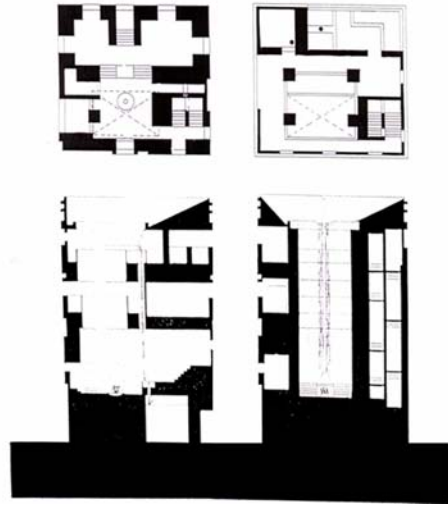
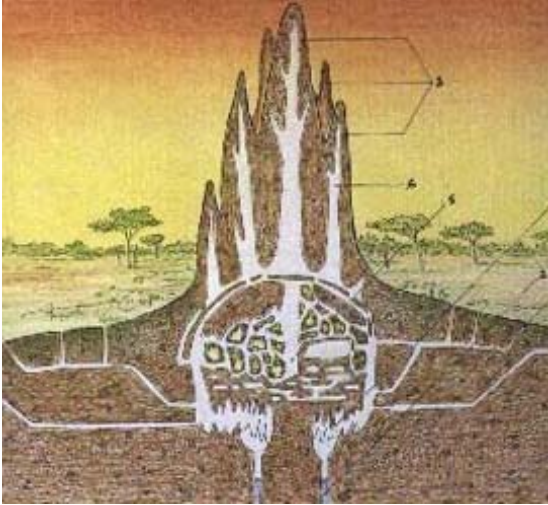
(above) Example of NYIT water project drawings and castings

Most students haven't heard of Bernoulli's principles or the Venturi effect but they know from experience that hot air rises and that fluids, including air, become less dense as they move faster. To put it another way, areas of low pressure induces the stack effect and natural ventilation within buildings, wind patterns against buildings, and gives rise to distinct configurations at the roof level. In the 1970's designers like Egyptian architect Hassan Fathy studied wind patterns in hot arid climates. Architects like the creators of BedZed, Michael Hopkins, and Alan Short have used knowledge of such patterns to create distinct aesthetic in the more humid temperate area of the British Isles. Without understanding and considering natural patterns and networks at work in design it is hard to understand how much a termite mound might teach us. Briefly, termites regulate the temperature of their mound through a complex set of air passageways that bring air down through the upper part of the nest, to an area below made moist by the activity of the hive. In this chamber the termite construct thin, concentric layers of earth + excrement on which moisture gathers. The incoming air evaporates this moisture, producing evaporative cooling which maintains the nest at a consistent temperature that varies from day to night and throughout the year by only one degree. There is a wonderful video of Dr. David Attenborough contorted inside a huge termite mound expounding on the creativity of these remarkable animals. As designers it is important to understand both human (social) systems and natural systems as interrelated. This relationship is represented in the much-studied communal termite architecture; the inhabitants work with natural patterns of ventilation to regulate the structure humidity and temperature.

The relationship of social and natural systems are explored in an NYIT fundamentals II project called "The Dig." The project introduces the fundamental issues of carved space and layers social relationships and understanding of place, through sunlight, water, ventilation and views into the project relationships.

For this exploration, students were given a tower 35 feet square by 70 feet high. The tower had a single existing opening, a cistern, and a rooftop courtyard, otherwise it was solid. A "journal entry" explaining the history of the tower and the journey of three archeologists- a navigator and expert on the movement of the sun and the constellations, an architect knowledgeable in ancient and modern architecture, and an anthropologist familiar with the political, spiritual and dietary practices of the related civilization- supplemented the project program.

In addition to the program elements to be excavated, including private spaces, communal rooms, service space, and circulation, students were given a complex list of constraints including structural requirements, natural light and ventilation, the capturing and use of rain water, and surveillance. Continuity of space and mapping of sequence were important considerations of the graphic presentations. Students began by analyzing design and formal precedent and graphically mapping and documenting the existing tower. Process models and drawings were explored both in positive and negative reversal.



(left) termite mound section. [www ldc.upenn.edu/myl/abm/index/html](http://www ldc.upenn.edu/myl/abm/index/html)

(right) example drawings from "The Dig" NYIT first year architectural design project

The termite mound and "The Dig" are representative of the complex interconnecting of 3-dimensional patterns over time. The examples discussed are intended to demonstrate that patterns and precedents necessary for a sustainable process does not require a change in the way that we teach design studios so much as a shift towards a new conceptual framework that defines the project problem set and the way in which we assess project outcomes. The base question is in how we reset priorities in the foundation year and build upon this systems thinking throughout the curriculum and into the ways that we practice as designers. The beginning design courses offer an opportunity to delay the interrelationships and patterns between our social systems and the natural patterns of our environment. This understanding is the first step towards an overall approach to interrelationships between projects, classes, and a systems approach to architectural design education. Developing sustainability as a value and sensibility, rather than a technology or format, must be cultivated early in a design students' education so as to set a strong foundation as a means to explore more complex interrelated issues as an inherent part of the design process.

The Solar Decathlon and like projects are not the only medium for exploration of the concepts we have tried to get at above, but a short description of the short-fallings and successes related to experience on three Solar Decathlon projects might be instructive. The Solar Decathlon is a multidisciplinary international competition sponsored by the Department of Energy every two years. Students from institutions of higher learning are challenged to design, build, and operate a house powered only by the sun. The competition proper is held around the fall solstice on the National Mall in Washington D.C.

Lisa Iulo was Faculty Advisor for Penn State's entry to the 2007 Solar Decathlon and Michele Bertomen was Faculty Advisor for NYIT's entries in 2005 and 2007. We both agree that, with emphasis, this was not an ordinary course load and

only dedicated faculty in good physical health, and extra-ordinary mental health, need consider this as an addition to their resume. Nonetheless, as students design some very interesting aspects of learning come to the fore.

First, as we all know, but must re-learn day by day: it's an imperfect world. Funding must be had, materials do not always show up on time, and even if everything works perfectly in some aspect of the program, there is always the weather. Seeing, responding, making sense and adapting to an environment made fluid by material exigencies as well as by social interaction becomes paramount.

Second, and most obviously, a multidisciplinary project where you build something that has to work breaks down the precious towers we construct in the name of disciplinary expertise or, in the worst case scenario, exacerbates and makes visible the pre-existing tensions between disciplines.

Third, the design and construction of a dwelling evokes in all of us the needs and desires associated with shelter and environmental conditioning. This takes two forms; The house cannot serve as what we would consider to be acceptable shelter without protecting from the elements, without providing environmental conditioning, or without power. So the garnering of heat and electrical energy from the sun, the use of water and mass to store this energy, the protective layers of insulation and water-proofing become real...almost like nest building.

An afterthought, that becomes all too evident as materials arrive and the houses takes shape, is how much unusable waste is generated by conventional house building. This is evident because both on campus and on the mall, waste disposal methods are primitive. So if the team isn't careful, the unused layers of drywall lie around and get soaked when it rains, mixing in with the unfinished cans of Red Bull attracting flies and piles of used water bottles accumulate on the site. The harried faculty advisor and, indeed, many members of the team are quite shocked by the extent of this waste. And one thinks longingly of nest building where the unused materials just melt back into the biomass; or of the termite nests made of excrement where waste re-utilization is a visible, cyclic pattern involving the bodies of those who inhabit.

Finally, the Solar Decathlon effects a change in sensibility. We are acculturated to validate ourselves in some way. The Solar Decathlon, despite its name, actively dismantles both notions of winners and losers, e.g. alphas vs. betas, prom queens vs. nerds, and the equally questionable notion that "we are all winners." Any team who makes it to the Mall must, at some point, shift its collective values from the individual to the collective... the "we work together to make our world" philosophy. Like the micro-environment created by the rhizome of the mangrove roots in the *Natural Geographic* photograph, the solar decathlon creates niches and eddies where a shark is no more important than the smallest mollusk and the production of hot water (as both teams found out on the Mall last October) can be thwarted by a tiny, inaccessible air bubble.





(left) Penn State MorningStar Home, (right ) NYIT Open House

*Understanding the active nature of our own concrete perceptions is crucial to the way in which we make sense of aesthetics and of its corollary, systemic holism.”<sup>10</sup>*

Certainly the Solar Decathlon is an intense and unique case. However, we have faith in the “investigative nature of the design studio” as an ideal environment through which alternative conceptual frameworks can emerge.<sup>11</sup> Taking Bateson’s open-ended and linear *Calibration and Feedback* relationship diagram a step further we arrive at a circular and interrelated dialogue of + Seeing + Responding + Making Sense + Adapting +. Where “seeing” is a static external image informed by our internal “imaging;” “response” is a feedback of knowledge gained from other systems or processes (natural patterns and site information in addition to collaboration and dialog in the interactive studio setting); “making sense” is the conscious act of processing; and “Adaptation”, returning to Bateson, is “a feature of an organism whereby it seemingly fits better into its environment and way of life.” This circular pattern informs a framework for responsible decision-making, a process of achieving that fit. As architects we translate Bateson’s ideas as a transformation of process from static figural representation to dynamic pattern recognition. We see this process as a diagram of relationships from seeing to responding to making sense to adapting – continually.

Adaptation is the reward of change. To come full circle designers must have respect for natural processes and a trust in others that leads to greater collaboration. Design must be both responsive and adaptive.

There are, of course, challenges and potential for failures in such a philosophy:

- Interdisciplinary collaboration is necessary, but difficult at best. Teaching loads and unit requirements are not set up to accommodate this structure.
- There is additional pressure put on the designer to understand relationships through the research necessary in the extra steps of “processing” and “making sense.” The studio might be supported by a seminar or course in ecology (or related systems thinking). However, is this feasible in an already overburdened curriculum? Do we add to the

general education requirements of entering freshmen to test their knowledge of biology and earth science?

- Movement or necessity? There is always varying expertise, interest, and perception of importance of “green” in design education. Mazria argues, in his 2010 Imperative for Architectural Education, that “because of the nature of architectural programs and their system of design studies, the education of students and faculty can take place almost overnight... due to the investigative nature of the design studio, students educate themselves through the research necessary to address the design problem, and –through studio critiques – they will educate their instructors as well.” A shift in values from an easy consumer to an equal participant mentality is necessary, but we are not there yet?...<sup>12</sup>

Rather than dictate technologies or strategies for sustainability, which are constantly changing, we need to teach students to educate themselves so that they and their designs will evolve and adapt to the interrelated and ever-changing environment. We must teach students to *make a virtue out of necessity*<sup>13</sup> and make a shift to look beyond preconceptions to an informed perception of the complexities of the world that all design is a part of.

We offer these ideas not as a proposal or clear solution, but as food for thought to stimulate like-minded educators to create environments for responsive decision-making that is the base and basis for sustainable design.



## Notes

1. paraphrasing Gregory Bateson
2. Capra, Fritjof. *The Web of Life: A New Scientific Understanding of Living Systems*, (First Anchor Books, 1996).
3. Morris, Berman. *The Reenchantment of the World* (Cornell University Press, 1981)
4. Harries-Jones, Peter, *A Recursive Vision: Ecological Understanding and Gregory Bateson* (University of Toronto Press Incorporated, 1995) p. 16
5. Ibid, p. 178
6. Bateson, Gregory, *Steps To An Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (Chandler Publishing Company, 1972)
7. Friedman, Jonathan Block, *Creation in Space: Fundamentals of Architecture* (Kendall Hunt Publishing Co, 1988)
8. Bateson, *Steps*, p. 147-49
9. McDonough, William & Braungart, Michael, *Cradle to Cradle / Remaking the Way We Make Things* (North Point Press, 2002)
10. Harries-Jones, p. 204
11. Mazria, Edward *"It's The Architecture, Stupid!"*
12. Ibid
13. Paraphrasing Gottfried Semper